suggests the relationship known to exist between some species of ants and plant lice. Such a symbiotic relation might well modify community life.

NUTRITION OF INSECTS IN RELATION TO MICROÖRGANISMS

Many insects live on plant food which is rich in carbohydrates but relatively low in protein. Because of the one fact insects may show great activity while, owing to the lack of protein, their growth may be both limited and slow. Some forms have a long life cycle altho ingesting great quantities of the substratum. This argues low metabolic rate in spite of large ingestion. On the other hand, many insects using fermenting vegetable matter with very low protein content have a very short and rapid growth period. This suggests an unapparent protein constituent. Baumberger (Jour. Exp. Zool., April, 1919) reports a study designed to discover the source of the protein supply of such insects. Drosophila in fermenting fruit, sarcophagous flies, coprophagous flies, fungus gnats, and other insects were used. The experiments on the Drosophila were especially thoro. By crucial experiments the author shows that the insect, while able to live on sterilized fruit alone, only has its normal rapid growth rate when this fruit diet is accompanied by microörganisms, particularly yeast. The yeast is a more adequate food than the fruit because of its higher protein content. Similarly the other insects, mites, and the like studied were shown to feed on microörganisms, thus generally supplementing their diet by the power of the fungi to extract, absorb, and synthesize the many non-protein compounds.

The author gives grounds for believing that this dependence of insects upon fungi is wide-spread. This is another measure of the great adaptability of insects in respect to available foods. Three modes of availing themselves of these high-class fungous foods are mentioned: (1) Ingestion of the microörganisms with the substratum, as in larvae of Drosophila, Musca, etc.; (2) Feeding directly on the microörganisms, as mites, crickets, many adult Diptera; (3) Preparation of an organic medium for the growth of microörganisms, as leaf-cutting ants, termites. Attention is called to the fact that animals other than insects go to the same source for food—as Protozoa, probably nematodes, and possibly earth worms.

In addition microörganisms are internal symbiants in insects and other animals. In the intestine of higher animals, these may elaborate protein from non-proteins, or serve other ends, as preserving a constant digestive flora. In still other locations, as fat bodies, coeca and the like, they may destroy waste products of metabolism, produce digestive enzymes, etc. The exact value of these internal relations, however, is by no means securely established.

PROBLEMS OF FERTILIZATION

In a book with this title, Lillie has placed in brief and semi-popular form a discussion of the problems of fertilization to which he himself has made notable contributions. Fertilization has long been recognized as a critical and decisive process in all plants and animals in which sex appears, and has appealed keenly to human interest from the earliest times. Every modern step in the study of genetics, variation, inheritance, and breeding from any angle whatsoever has paid tribute to and received support from investigations in the chemical and architectural composition and the behaviour of the egg and sperm as these cells unite in fertilization.

In the first chapter the author traces the history of human speculation and discovery in respect to eggs and sperm and the manner and meaning of their coming together. Few items of biological progress illustrate better the gradual passage from the metaphysical philosophical subtleties of *a priori* reasoning than this field shows. The discovery of the living sperm, by Leeuwenhoek and others, soon after the invention of the microscope, at first only gave a more riotous zest to these speculations. But gradually increased knowledge of the facts, coupled with definite limiting experiments, chastened these theories and led to the recognition of the coördinate value and function of the male and female elements.

The intimate cytological investigations of the last quarter of the nineteenth century finally brought into clear view the full significance of the cell—and nuclear—theory and made possible its final application to fertilization. There has been no more brilliant biological work in any field than that which relates to the behavior of the nuclear elements in maturation and fertilization.

There are two sets of problems at this point "where all the strands of the webs of two lives are gathered in one knot, from which they